

GEODETIC PROGRAMS NEEDS OF LOUISIANA AND WISCONSIN

Report to Congress

Executive Summary

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
National Geodetic Survey

August 2001

EXECUTIVE SUMMARY

DIRECTION FROM CONGRESS

This document was prepared in response to the direction contained in House Report 107-139 (to accompany H.R. 2500 - Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Bill, Fiscal Year 2002) that the National Oceanic and Atmospheric Administration (NOAA) "*... is directed to work with the states of Louisiana and Wisconsin to assess their requirements for similar [NOAA Geodesy] programs and report back to the Committee by September 15, 2001.*" This report assesses the requirements and potential benefits of Louisiana and Wisconsin participating in the National Height Modernization System and geodetic spatial reference programs.

OVERVIEW

Height Modernization Study to Height Modernization System

Height modernization is an effort, led by the National Geodetic Survey (NGS), to enhance the vertical component of the National Spatial Reference System (NSRS). NSRS is a consistent national reference framework that specifies latitude, longitude, height (elevation), scale, gravity, and orientation throughout the United States, as well as how these values change with time. NSRS provides accurate knowledge of the size, shape, and position of our environment, as seen daily in the construction and safety of roads and buildings, the transportation of goods and people by car, ship or plane, as well as in the monitoring and protecting of our environment. Height modernization includes a series of activities designed to advance and promote the determination of high accuracy elevations through the use of Global Positioning System (GPS) surveying, rather than by classical line-of-sight leveling.

In 1998, the United States Congress directed NGS, an office within the National Ocean Service of NOAA, to conduct a National Height Modernization Study¹ to determine the effectiveness of height modernization in California and North Carolina. Major findings of the study concluded that the height modernization needs that could benefit all states are:

¹ U.S. Department of Commerce, June 1998, **National Height Modernization Study**, Report to Congress.

- A reliable, cost-effective, standardized, legally established national vertical reference datum (i.e., North American Vertical Datum of 1988 (NAVD 88)) and the infrastructure (i.e., NSRS) through which to access and utilize it.
- The capability to easily interrelate the many vertical datums currently in existence, but particularly with respect to a standardized national vertical reference datum (coordinate system).
- National technical standards and guidelines for using GPS to determine heights.

The study addressed the national need for and benefits to be derived from enhancing the vertical component of NSRS, while focusing specifically on the states of California and North Carolina. In Fiscal Year (FY) 2000, NGS received funding "for initial planning of the National Height Modernization System Demonstration, based on the recommendations contained in the National Height Modernization Study, in California and North Carolina." NGS received additional funding in FY 2001 in support of height modernization activities in California and North Carolina. In California, the California Reference Spatial Center (CSRC) was created. The CSRC offers a state-of-the-art position and height system to aid public health and safety, preservation of valuable resources, and improved business productivity. In North Carolina, four urban areas will soon receive height modernization surveys, conducted through contracts with the private sector, that will modernize their transportation, land survey, and emergency response systems. This funding has led to the implementation of the National Height Modernization Study and the development of a height modernization system in these states.

Assessment of Louisiana and Wisconsin

Rapid land loss and continuous elevation (height) changes in Louisiana require a well-managed and monitored federal/state geodetic control network to protect the environment, ensure safety of its citizens, and enhance prosperity within the state. Currently, 25 to 35 square miles of wetland per year are lost in Louisiana due to ground subsidence (sinking of the land) and coastal erosion.² Cities and cultures are at risk of losing their

²Louisiana Coastal Wetlands Conservation and Restoration Task Force and Wetlands Conservation and Restoration Authority, 1998, **Coast 2050: Toward a Sustainable Coastal Louisiana**, Executive Summary, Louisiana Department of Natural Resources.

land and having to relocate. Flooding and sea level rise threaten the coastal region, most of which is only three feet above sea level. Flood plain models and evacuation plans, developed using outdated elevations, put the citizens of the low-lying areas at great risk during heavy rains. The current available geodetic control does not support the state's needs to evaluate and manage the changes in its environment and the impact on its economy and ecosystem. Problems with historic surveys, land movement, and sea level rise have made the current vertical geodetic control in Louisiana obsolete, inaccurate, and unable to ensure safety.

In Wisconsin, the existing federal/state geodetic control network simply does not support today's design and construction projects. Land in Wisconsin is susceptible to frost heave (uplifting of land) and post-glacial rebound (rising of the Earth's surface). As the land moves, often the survey monuments move, making the previously determined height information for the points inaccurate. Additionally, in most parts of the state, 50 percent or more of all bench marks have been destroyed due to construction and land development activities. The critical nature of the shortfall of accurate geodetic control, especially vertical control, prompted the Wisconsin Land Information Board to establish a State Elevation Data Task Force to assess the needs and uses for vertical control and directly address the deficiencies. National, state, and local agencies, as well as the private sector, need consistent and accurate geodetic control for use in highway and land development, monitoring and modeling of shoreline and flood plains, and safe and economical transportation of goods.

Process of Assessment

This report identifies and documents the user requirements in Louisiana and Wisconsin for height information, including those requirements utilizing both horizontal and vertical data. To identify and document this information, a two-step process was followed. First, the NGS state advisor and NOAA program coordinator in Louisiana and the NGS state advisor in Wisconsin contacted the users within their state and documented their input. Next, NGS conducted user forums on August 8 in Madison, Wisconsin, and on August 13 in Baton Rouge, Louisiana, to obtain further insights and recommendations from state and local governments, the private sector, and the academic community. Due to the short time frame for completing the report, NGS believes Louisiana and Wisconsin are in general agreement with our assessments, however, the states did not have the opportunity to review and comment on the report.

FINDINGS

Based on the above information which was analyzed by NGS, it has been determined that participation by Louisiana and Wisconsin in the National Height Modernization System could result in:

- improved disaster preparedness;
- accurate digital elevation models, enabling better flood plain analysis and determination of flood plain needs;
- improved coastal and harbor navigation, enabling safer and more cost-effective shipment of goods;
- improved aircraft navigational aids, and safer approach and landing procedures;
- accurate determination of coastal erosion rates and flood plain boundaries;
- advanced surface transportation control and monitoring;
- improved land and marine geographic information systems (GIS) and assessment of environmental effects on regions influenced by water level changes;
- enhanced agricultural practices resulting in reduced run-off water pollution;
- more efficient fish farming, including crawfish farming;
- infrastructure monitoring of subsidence and erosion;
- better management of natural resources through the use of reliable GIS;
- improved understanding of tectonic movement; and
- significant time and cost savings in field surveying.

Both Louisiana and Wisconsin require improved vertical geodetic control that would make possible the applications and benefits listed above. They each have unique geophysical situations that represent problems specific to their regions that would be improved through participation in the National Height Modernization System.

RECOMMENDATIONS

The report clearly identified the need for height modernization in Louisiana and Wisconsin. Based on our assessment of their needs, NGS provides the following recommendations:

Louisiana

1. **Perform additional GPS measurements and leveling on bench marks to establish the basic framework of survey points needed to support height modernization in Louisiana as recommended in the 1998 National Height Modernization Study.** The framework, designed specifically to meet Louisiana's needs, would be funded through outside sources and grants and would provide

accurate, reliable, and consistent height information referenced to NAVD 88 to be included in NSRS.

2. **Expand the current network of CORS and explore the use of additional height monitoring stations (i.e, Port-A-Measures (PAMs) and extensometers) in Louisiana.** The combination of CORS throughout the state and mobile and stationary height monitoring stations concentrated in subsidence areas together provide an accurate statewide height monitoring system referenced to the highly accurate National CORS network.
3. **Establish a Louisiana Spatial Reference Center (LASRC).** Like California, Louisiana does not have a state agency coordinating efforts to improve the geodetic reference frame and requires a Spatial Reference Center to work in conjunction with NGS to support height modernization within the state.

Wisconsin

1. **Accelerate the Wisconsin Height Modernization Program (WI-HMP) from ten to five years. Analyze data collected in the early phases of the WI-HMP to determine possible modifications to field procedures and the design of the program.** Specifically, assess the amount of leveling to be completed and the current specifications and guidelines of the field observations to ensure accurate, yet economic, development of height modernization.
2. **Promote Wisconsin as a role model and trainer in height modernization.** Since Wisconsin's height modernization effort is already underway, the state would be in a position to advise neighboring states in the development and uses of height modernization. Transfer of technology through NGS with Wisconsin as a regional leader could help address the entire region's economic and environmental issues.
3. **Investigate opportunities for additional funding for the height modernization in Wisconsin.** Additional resources would result in more outsourcing opportunities, as well as technology transfer, to private surveyors.